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MOSSES AND THEIR ALLIES.

CLUB-MOSSES AND LIVERWORTS.

CHAPTER III.

THE manner in which a connected chain appears to be kept up between the different families of created beings, animate, and inanimate, which inhabit this earth, is a circumstance so remarkable, that few thinking minds can have failed to observe it. There are, indeed, distinctive marks which separate race from race, but there are also distinctive resemblances which unite them, linking one to another in a regular gradation from the highest to the lowest. Thus we find it among plants; we descend step by step from the mighty cedar which stretches out its arms in Lebanon, to the mildew which overspreads a mouldy crust; and although, on comparing these two objects, we find little of similarity between them, yet in each step of our descent we invariably perceive a something which connects the one with the other, and discover no break in the chain, no step which does not lead to the next, until we find ourselves at the outer limits of vegetable organisation.

One order being thus allied to another, one class to the next, both above and below it in the scale of creation, it is not easy, when we speak of *allied* tribes, to know exactly where to draw a line, which to take, and which to leave. We have spoken of mosses and lichens as in close affinity to each other, and we must now name two other tribes which claim relationship with them both, one of them standing higher, the other lower in the scale.

The first of these, the Club-Mosses, or *Lycopodiaceæ*, "precede" the mosses, and form the link between them and the ferns. The second, the "Scale-Mosses" and "Liverworts," or *Hepaticeæ*, *follow* the mosses, and unite them in brotherhood with both the Lichens and the Algæ; there being species in this tribe which partake largely of the nature and structure of both those orders.

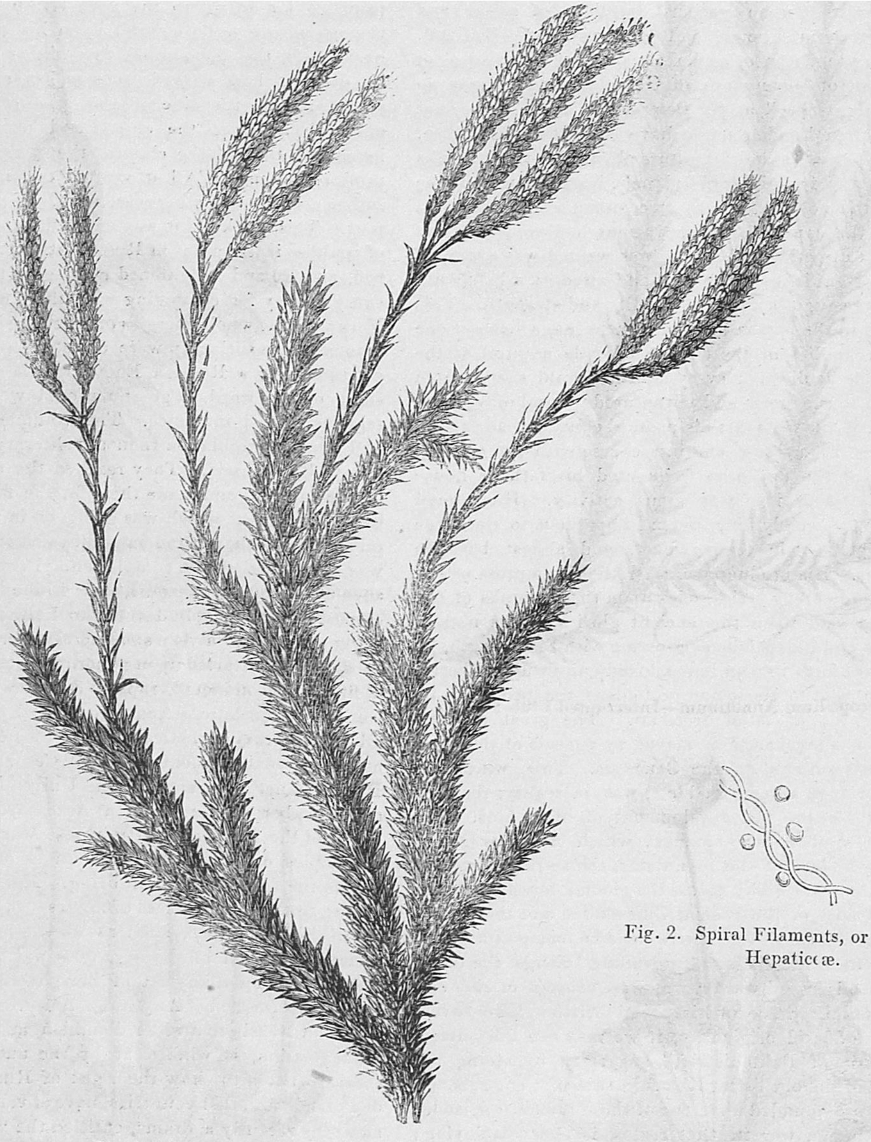

Fig. 1. Lycopodium Clevatum—Wolf's-claw or Stag's-horn Moss.

Fig. 2. Spiral Filaments, or Elaters of Hepaticæ.

The organisation of the *Lycopodiaceæ*, or Club-Mosses, will be found well worthy the attention of those who delight in looking into the minutiæ of creation, and desire to find subjects for praise and adoration of the Great Creator in the works which he has made. The order contains but two families, the Club-Mosses and the *Isoeteæ*, or Quill-Worts.

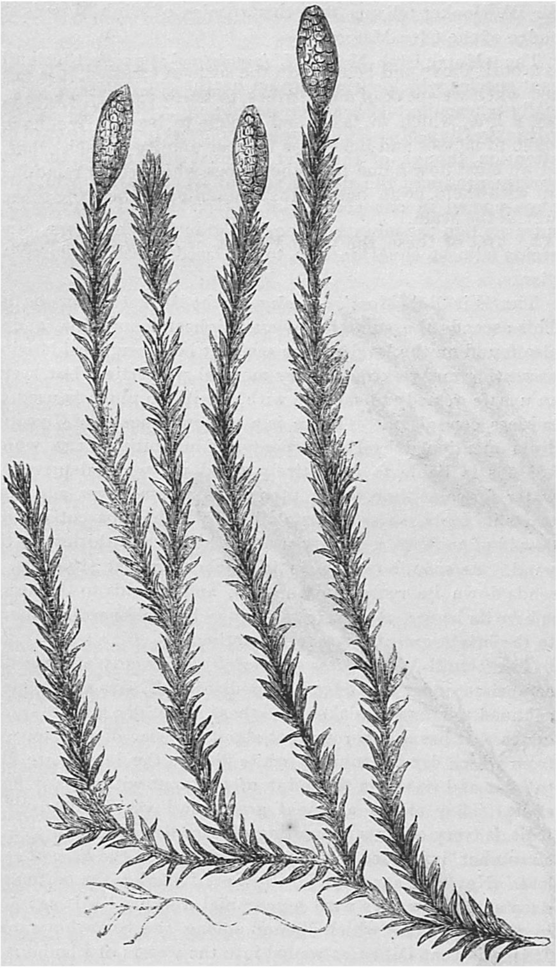

Fig. 3. Lycopodium Annotinum—Interrupted Club-Moss.

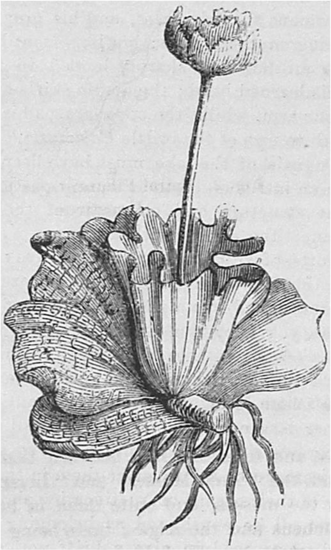

Fig. 5.—The Dwarf Scale-Moss.

The Club-Mosses have a tough, persistent stem, beset with hard short leaves. There are no veins in their leaves, which are, however, furnished with large stomata, or apertures in the cuticle, for the admission of air to the cellular tissue of the plant, and are for the most part narrow and taper-pointed. The stems are frequently twelve or thirteen feet in length, and in some species raise themselves into an erect position and become woody; thus approximating to the character of some Coniferæ. In the coal strata are found some curious fossilised remains of gigantic Lycopodiaceæ, which are called *Lepidodendra*, or scaly trees, from the mode of the arrangement of their leaves. These seem to establish the connection between the two groups—the Club-Mosses and the Coniferæ. The fructification of this group consists of a short spike, formed by a prolongation of the branch, round which are clustered number of two-valved capsules. These are sometimes of two kinds; one containing a mass of fine powdery granules, the other, including only three or four roundish, fleshy bodies, is very much larger size than the granules. Both these kinds of

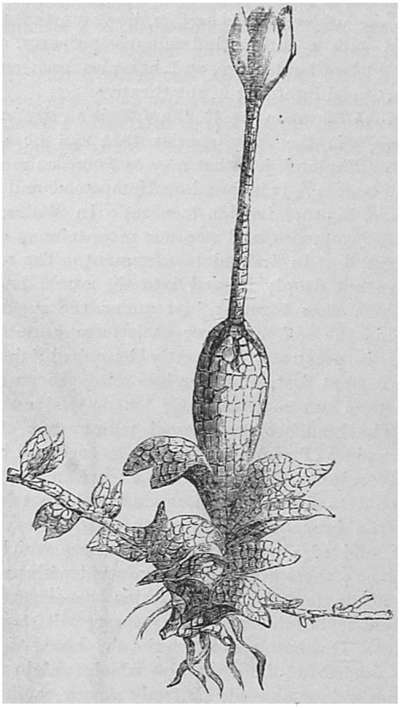

Fig. 4.—The Pear-shaped Scale-Moss.

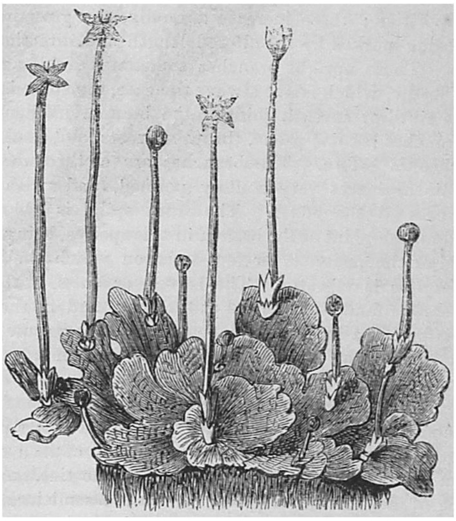

Fig. 6.—The Broad-leafed Scale-Moss.

capsule lie among the hair-pointed leaves of the head, one in the bosom of each leaf, and inclosed in pale yellow cases. Whether both these kinds, the powder and the spores, have alike the power of reproducing their species seems as yet not to be determined, and botanists differ as to which of them is to be considered as the seed. Lindley tells us, that the larger bodies are the reproducing organs; Decandolle thinks that the one fertilises the other; but nothing seems clearly ascertained on the subject. It is certain, however, that the powder is endued with a curious inflammable property, and is used in making the Chaldee fire, and has also been employed in making artificial lightning at the theatres.

Lycopodium Elavatum (fig. 1), the "Wolf's-claw" or "Stag's-horn Moss," is the only species that can be said to be common in England, but that may be found on most elevated moors and heaths. It is found on Hampstead and Hounslow Heaths, and in other London localites. In Wales, Scotland, and the lake countries, and in other mountainous districts, it is abundant, but in Ireland less frequent. The roots of this species are not deeply infixed into the earth, but they run matting themselves together just under the surface, serving thus to bind the soil, and prevent it from crumbling away. The stem is prostrate, frequently branched; the branches slightly raised at first, and then becoming procumbent; these branches thus run sometimes for ten or twelve yards from a centre. The branches are covered with narrow, flat, smooth leaves, the edges of which are slightly toothed and hair-tipped. These leaves do not fall off, but are evergreen and persistent. When about to form fruit there are thrown out from various parts of the branches spikes clothed with leaves, longer, narrower, and of a paler green than those which beset the original stem; these branches are crowned with pale sulphur-coloured heads, something like catkins, usually two on each stem in pairs, but in some cases three will start from the same point. On these spikes are the two kinds of fruit which we have described. The capsules which contain them are in this species kidney-shaped, perfectly sessile, and situated at the base of the bracts. Each is two-valved, and full of either spores or powder.

Lycopodium annotinum, the "Interrupted Club-Moss" (fig. 3), is another very interesting species of this genus, of rare occurrence in the British Isles, but common in Norway, Sweden, and in North America. The roots of this species are tough, wiry, and tortuous, the stem creeping, very strong, and with a deeply-indented and striped surface. It sends out at intervals branches from one to three or four inches apart, in an erect position; these increase annually, the growth of each year being marked by the altered length and direction of the leaves. These upright branches sometimes divide again, and when fertile, which is not always the case, the spike is usually on the sixth or seventh joint of the branch. When mature, the branches become prone, throw out roots, and send up erect branches as before. The branches are clothed throughout with linear leaves very acutely pointed, and with minute serratures at the edges. The front spike is oblong, and seated on the point of the branch in this species, being entirely devoid of the peduncle or foot-stalk on which the spike of *L. clavatum* is elevated. The leaves, or *bracts*, in the spikes are nearly round, yet pointed at the apex, and in the axil of each is placed a large conspicuous veniform capsule, which, when ripe, opens transversely, and sheds numerous minute sulphur-coloured seeds.

Lycopodium Alpinum, the "Savin-leaved Club-Moss," is more common than the last-named species; it is a pretty plant, its foliage of a brighter green than any other of its congenors, and in summer the young shoots have a blue tint. After the escape of the seeds, the spikes bend into a semicircular form, and the bracts become reflexed. Sir W. Hooker tells us that it is much used in Iceland as a dye for woollen cloths. He says, "a vast heap of *Lycopodium Alpinum*, lying before the priest's house, drew my attention, and on inquiring, I found that it was used for the purpose of giving their wadmal a yellow dye, which is done by merely boiling the cloth in water with a quantity of the *Lycopodium*, and some leaves of *Vaccinium uliginosum* (the Bog Whortleberry). The colour imparted by this process, to judge from some cloth shown me, was a pale and pleasant, though not a brilliant, yellow." Wadmal is the woollen cloth usually worn by the Icelanders. Sir W. Hooker tells us that this species of Club-Moss is the badge of the Clan Macræ.

The "Marsh Club-Moss" (*L. inundatum*) is a rather insignificant species which springs up on heaths and commons, especially where the turf has been pared; and neither that nor the "Prickly Club-Moss" (*L. selaginoides*) must receive much of our attention, though of the latter we must just notice that this species produces the double sort of fructification which we have named in our account of *L. clavatum*. The upper capsules contain the minute pollen-like granules, the lower larger grains almost equal in size to the seeds of some flowering plants.

The "Fir Club-Moss" (*L. selago*) is the last species on our list. This ascends the summits of our highest mountains, and is also found on the level of the sea. It has been considered as possessing many extraordinary medical properties, but seems an unsafe remedy to meddle with, as, if too much is used, it induces convulsions. There is a curious species of Lycopodium mentioned by Dr. Carpenter as inhabiting Peru, which he says is liable to be entirely dried up when deprived of water for some time. "It then folds in its leaves and contracts its roots, so as to form a ball, which, apparently quite devoid of animation, is driven about hither and thither by the wind. As soon, however, as it reaches a moist situation, it sends down its roots into the soil, and unfolds to the atmosphere its leaves, which, from a dingy brown, speedily change to the bright green of active vegetation."

The "Quill-Wort" (*Isoetes lacustris*) is the only other genus comprised under the order Lycopodiaceæ. This is a little plant confined to mountain lakes, and there is but one species in the genus. It has a tuberous root about the size of a hazel-nut, from which depend tubular white fibres; the leaves are also tubular and rise from the point of the root without any foot-stalk. They are of a bright green, and very brittle. The fruit is very curious, consisting of capsules about the size of swan-shot, imbedded in the very substance of the base of each leaf. Newman says, the Quill-Wort "clothes the bottoms of deep and still waters with a perennial verdure." It is found in the little lakes which abound among the Snowdon range. It is said that Dillenius waded into the waters of Llanberis to get it, and Newman glories in the fun of his exploit. "The imagination of a botanist," says he, "delights to picture the Sherardian professor in this interesting situation: his shoes with their enormous silver buckles, and his grey-ribbed hose, are seen reposing on the strand; his important bag-wig, and his formidable military hat sharply looped on three several sides, adorn his learned head; the ample skirts of his coat are gathered on one arm, whilst the other grasps his gold-headed cane wherewith to uproot the brittle *Calamaria*." Surely the nymphs and naïads of the lake must have been a little surprised at such an intrusion on their watery pastures!

Such is the structure and character of the tribe which appears to connect the mosses with the ferns.

The Liverworts, of which we have next to give some account, come lower in the scale of organisation; they are much varied in size, appearance, and structure, and some of them are of exceeding beauty. They muster under their banner some genera which closely resemble true mosses; others which are nearer the structure of lichens; and again others which link them with the Algæ, Jungermanniæ, Marchantiæ, Trgioniæ, and a few other less noticeable genera, are all of this tribe; but they differ so widely from each other that we shall scarcely from their appearance be led to place them in the same order. The similarity of their organs of fructification shows, however, that they must all be considered as belonging to the order *Hepaticeæ*, and we proceed to give a brief notice of a few of the most interesting genera.

The *Jungermanniæ*, or Scale-Mosses, so named from Louis Jungermann, a German botanist, are of a very peculiar and exquisitely delicate structure. The whole substance of the plant is loosely cellular, so much so that, although most of the species are exceedingly minute, the beautiful reticulation of the leaves may often be detected by the naked eye. The herbage consists of a variously dilated frond, frequently naked, but more often covered with small leaf-like appendages. These are often divided, but never truly nerved, and might more properly be considered as dilitations of the frond.

The Scale-Mosses may be considered as divided into two classes: the foliaceous, or those which have the appearance of separate leaves; and the frondose, or those which consist of lobed fronds or thalli.

The former of these divisions is composed of minute plants, which by an unaccustomed eye might be taken for true mosses, amongst which, in many instances, they are found growing. These are widely spread over the ground on banks and trunks of trees, or other positions in shady woods; some are found on moist Alpine moors, frequenting the beds of torrents, or growing in boggy places, along the edges of springs, or rivulets, whilst we find some species spread out on clay and exposed heaths, exhibiting their pretty purple or bronze foliage where nothing else will grow.

The second, or frondose, division of this tribe is chiefly confined to semi-aquatic positions: they are larger, their leafy parts, or fronds, are thicker, broader, and of a different texture from the foliaceous kinds, and some of them are slimy to the touch; but there are one or two of this division, namely, the "Forked," and the "Downy Scale-Mosses," which grow on stones, trunks of trees, and on shady limestone rocks.

The fruit of this last genus is a theca or capsule which rises from a tubular leaf or cluster of leaves called the Perichætium, and is usually borne on a seta or fruit stalk. The theca lies involved in this protecting sheath until it is mature enough to make its appearance in the world; the perichætium then opens at the top, and the little theca, unlike the modest little mosses which never lift their young heads to the light without the covering of their calyptra or veil, suddenly starts up, leaving that organ attached to the point at which it originally grew, and displays itself unveiled to the eye which may be sharp enough to detect its diminutive beauties. This theca is four-valved, in shape much like those of mosses, but it has no lid, and no central column round which the spores assemble; instead of this it is furnished with some very curious spiral filaments with which the spores are associated (fig. 2). It is in the possession of these spring-like organs alone that the different families which class under the general name of Hepaticeæ resemble each other, but these are common to the Jungermanniæ, the Marchantiæ, and all the rest of the genera which the order comprises. These organs consist of double spiral threads, somewhat like the trachæ or spiral air-vessels in plants, only more elastic. They are contained in the same case with the spores and curled up among them, and when the capsule is mature, spring up with a sudden jerk like a jack-in-a-box, and scatter the spores which are around them in all directions. So sensitive are these *elaters* that even breathing on them will set them in motion after the spores have escaped. The Scale-Mosses chiefly differ from true mosses in the permanent attachment of the calyptra of which we spoke above, and in having no lid or *operculum*, and no columella. The tubular form of the sheath and the presence of the spiral filaments, just described, constitute the other distinguishing features of the genus. Besides the normal fructification, the Jungermanniæ possess a second kind of reproductive organ by means of which the species are often propagated; these are called *gemmæ*, and consist of minute roundish, or oblong bodies, variously situated, sometimes in the axil of the leaf, at others on its margin, and clustered together in the form of little bells.

The colour of the Scale-Mosses varies through all the shades of green into brown, yellowish, dusky purple, and bronze. The theca is usually black, or deep purple, or dark brown, although occasionally it is nearly transparent.

The seta or fruit-stalk is in most cases semi-transparent and as delicately reticulated as the other parts of the plant. Our example, the Pear-shaped Scale-Moss (*J. turbinata*, fig. 4.) shows this very beautifully. This species is one which is frequent in moist shady spots in limestone districts, and we have selected it as illustrative of the highly cellular structure of plants of this tribe. *J. pusilla* (fig. 5), the Dwarf Scale-Moss, is given for the purpose of exhibiting the beautiful form of its folded sheath or perichætium. The plant is of a tender green, the capsule brown, and the edges of the bell-shaped sheath of a delicate pink. This is given, as are all the other Scale Mosses of which we present drawings, as they appear when magnified to about six times the natural size.

Sowerby says, in speaking of mosses, that which may with equal truth be said of the tribes which at present engage our attention: "It is chiefly in the economy of nature that we must look for the utility of these little plants, that she has fashioned with so much care, and for the reproduction and dissemination of which she has invented so beautiful and complicated an apparatus as that described above, though they are destined for the most part to flourish where no human eye beholds that beauty, no intelligence, save her own, can calculate the necessity and advantage of their existence. Their ministry is pursued in concert with other families lower in the scale of vegetable being; the smaller species assisting in the production of soil upon newly formed lands, clothing with verdure the most barren spots, and gradually fitting them for the support of the higher order of plants; while the larger are occupied in no small degree in the production of land itself, especially the aquatic kinds, which fix themselves upon the surface of lakes and stagnant waters, already interlaced with the slender stems of the *Charæ-Conferoæ*, and plants of similar habit, gradually converting the liquid plain into a partially solid one, on which eventually grasses, rushes, &c., are capable of growing; thus are formed morasses, which, by a further progress of vegetation, become at length fertile meadows. While thus slowly operating to increase the extent of the habitable world, their influence directly and indirectly affects in various ways, but more frequently, perhaps, unseen and unsuspected, the welfare and interest of those who are too apt to despise their apparent insignificance, and too proud to stoop to the examination of their surpassing beauty." Of the species which render their feeble aid in thus converting water into land, are some of the little frondose Scale-Mosses, and also some of the other tribes of the hepaticeæ. The Broad-leaved Scale-Moss (*J. Epyphilla*, fig. 6), which is depicted of the natural size, is one of these. It is frequent on moist heaths, and in damp woods, and thickets, especially by the sides of wells and rivulets. The Slippery Scale-Moss (*J. Pinquis*) is another of this description.

We next come to the family *Marchantiæ*, named from Nicholas Marchant, a noted botanist. It is a pretty and singular tribe, its trivial name, liverwort, being derived from a fancied resemblance to the human liver; this resemblance was supposed to indicate some special virtue in the plant, as connected with that organ, and in olden time it was considered a specific for jaundice and other such disorders. The marchantiæ grow on earth or the bark of trees in damp places, spreading over the ground in the form of a green incrustation, from the lower surface of which root-fibres are developed. This crust or thallus is entirely composed of cellular tissue, the cells of the outer layer being closer in texture than the rest, and forming a thick leathery cuticle, in which are large stomata. The fruit consists of a head of spore-cases, radiating from a central disk called the "shield," like the spokes of a wheel. The head is mounted on a long stalk springing from a bell-shaped sheath, which starts from the surface of the frond or thallus, usually at the margin. The spore-cases or thecæ open by irregular fissures, either four or eight in number. Besides this normal fruit, *gemmæ*, or detached buds, of quite a different structure, are found on these plants. These are small leafy bodies which spontaneously separate from the parent plant, and when mature are washed out by the rain, and carried abundantly to new localities, where they spring up and grow very rapidly. The form of the thalli or fronds of the marchantiæ is thus quaintly described by the good old herbalist Gerard :—"Liverwort is a kinde of mosse which spreadeth itself abroad upon the ground, having many uneven or crumpled leaves lying over one another, as the scales of fishes do; greene above, browne underneath." These fronds are variously lobed, their colour is a living green, and when broadly spread over a damp bank or the wall of a fountain or reservoir of water, they form a beautiful object. The Germans have the same name for the tribe as ourselves, and call it *leberkraut*. The Conical Liverwort (fig. 8) is common. It is of a yellowish-green tinged with brown; the peduncle, or fruit-stalk, is white touched with pink, and fleshy. It springs from a concave disk, usually situated in the marginal clefts of the fronds. The sporules are large, of a dark olive hue.

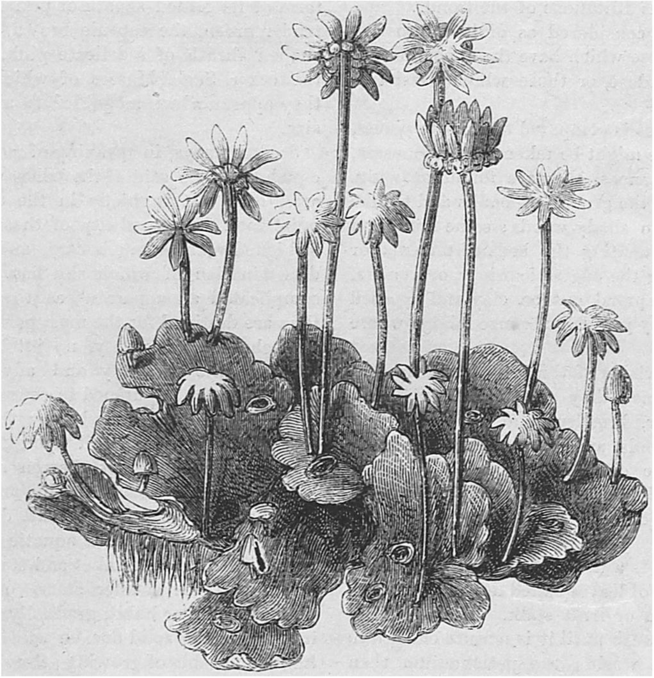

Fig. 7.—Star-headed Liverwort.

The other example given (fig. 7) is of the Star-headed Liverwort (*M. polymorpha*), a species even more common than the conical.

Of the other genera which the order *hepaticeæ* comprises we shall say but little, as they are few and, in comparison, insignificant.

Targionia hypophylla at first sight resembles a marchantia, but differs in its fructification, which is globose and nearly buried in the margin of the frond; and this, with anthocerus punctatus, sphærocarpus terrestris, and a few species of a little tribe called *riccia*,—on which, as they are for the most part little known and not of much general interest, we shall not enter particularly,—complete the number of the genera contained in this order.

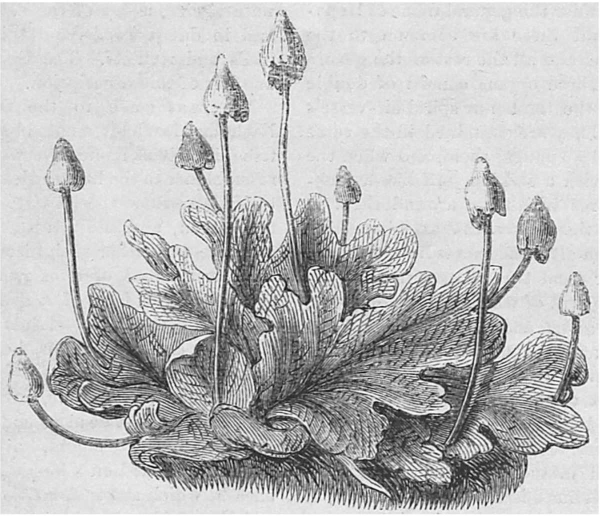

Fig. 8.—Conical Liverwort.